Geologic Map of the Lower Escalante River Area, Glen Canyon National Recreation Area, Eastern Kane County, Utah

Utah Geological Survey
a division of
Utah Department of Natural Resources
in cooperation with the
National Park Service

by
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2006

Plate 1
Utah Geological Survey Miscellaneous Publication 06-3DM
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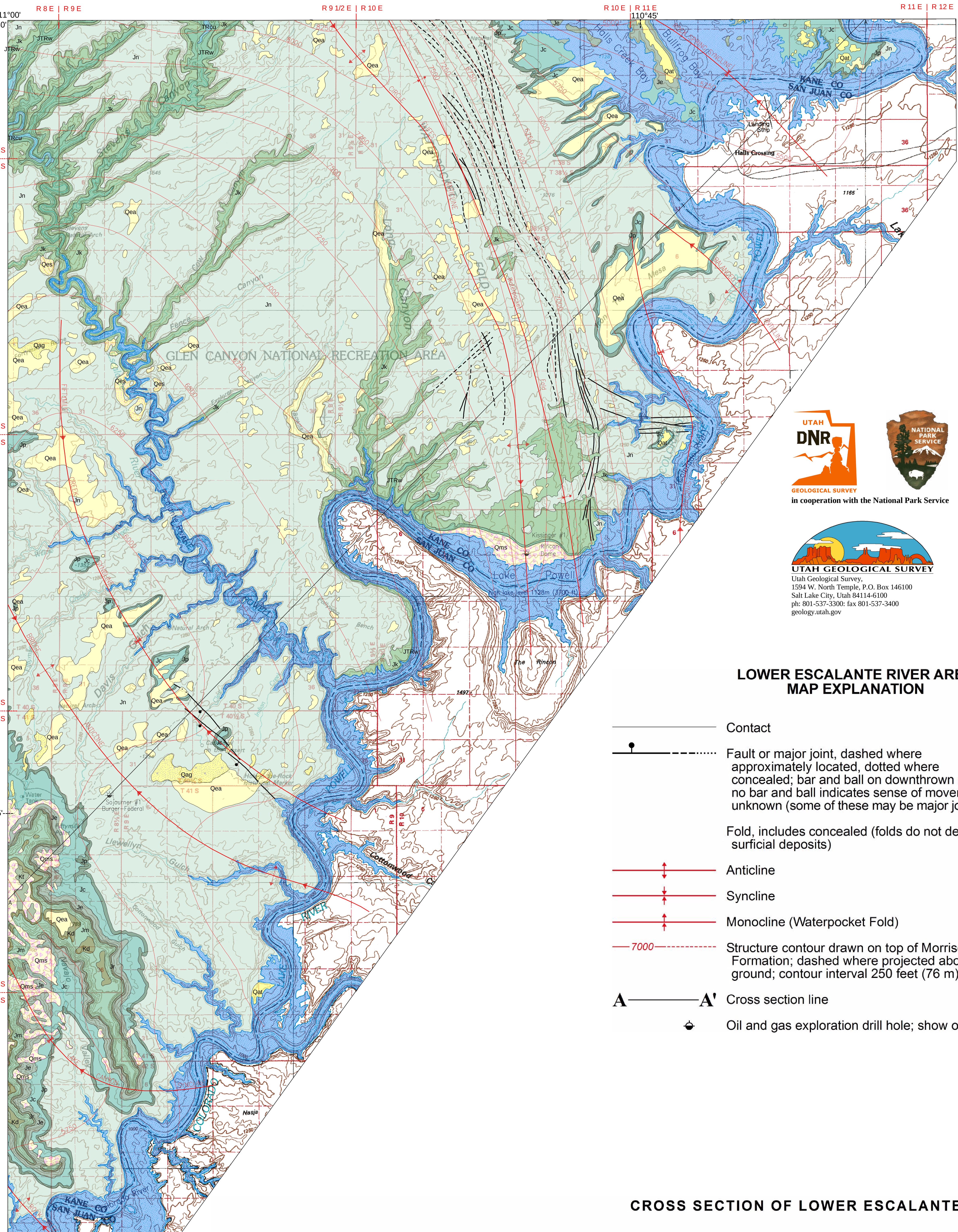

in cooperation with the National Park Service

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LITHOLOGIC COLUMN - LOWER ESCALANTE RIVER AREA

SYSTEM /SERIES		GEOLOGIC UNIT	SYMBOL	THICKNESS Meters (Feet)	LITHOLOGY
CRET.	Upper	Tropic Shale (partial)	Kt	60+ (200+)	
	L.	Dakota Formation	Kd	14-17 (45-55)	Unconformity
J U R A S S I C	Upper	Morrison Formation	Jm	170-210 (550-680)	
		Romana Sandstone	Jr	12-40 (40-130)	Unconformity / Unconformity
	Middle	Entrada Sandstone (Cannonville and Gunsight Butte Members)	Je	220-240 (720-780)	
		Carmel Formation (Winsor and Paria River Members)	Jc	33-52 (110-170)	
		Page Sandstone	Jp	10-75 (30-250)	Unconformity
	Lower	Navajo Sandstone	Jn	290-425 (950-1400)	
		Kayenta Formation	Jk	58-104 (190-340)	
		Wingate Sandstone	JTRw	60-90 (200-300)	Unconformity?
TRIASSIC	Upper	Chinle Formation - upper unit	TRcu	70+ (230+)	

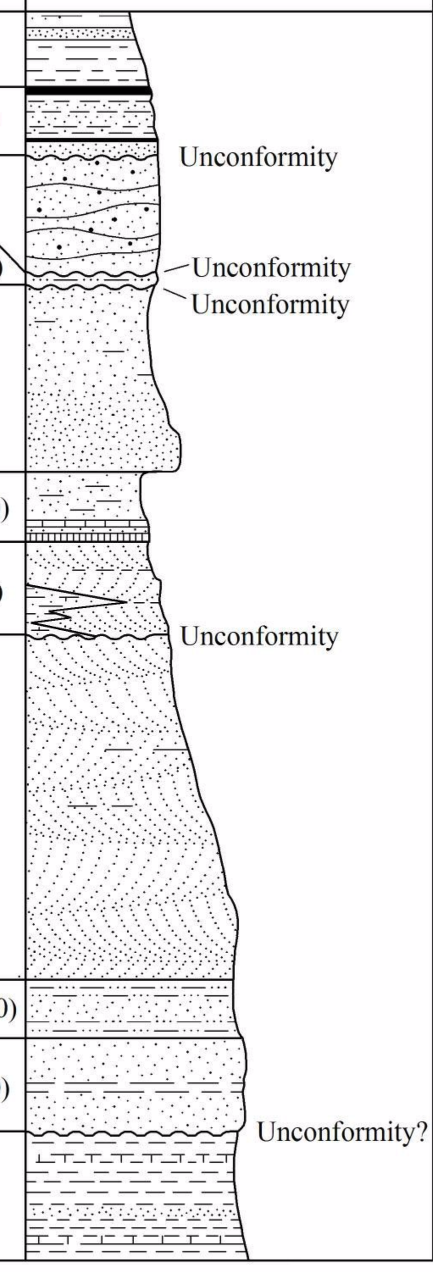


Diagram is schematic-- no fixed thickness scale

LOWER ESCALANTE RIVER AREA MAP EXPLANATION

Contact

Fault or major joint, dashed where approximately located, dotted where concealed; bar and ball on downthrown side; no bar and ball indicates sense of movement unknown (some of these may be major joints)

Fold, includes concealed (folds do not deform surficial deposits)

Anticline

Syncline

Monocline (Waterpocket Fold)

7000 Structure contour drawn on top of Morrison Formation; dashed where projected above ground; contour interval 250 feet (76 m)

A——A' Cross section line

Oil and gas exploration drill hole; show of oil

LOWER ESCALANTE RIVER AREA CORRELATION

QUAT.
Qa, Qag, Qat, Qea, Qes, Qmst — Alluvium (present in deposits too small to map), alluvial gravel (stream terrace, pediment), alluvial terrace (Colorado River), mixed eolian and alluvial, eolian sand, mass-wasting deposits (colluvium, landslides, talus, etc.)

unconformity

CRET. Upper
Kt Tropic Shale

CRET. L.
Kd Dakota Formation

unconformity

JURASSIC Upper
Jm Morrison Formation (mostly Salt Wash Member)

unconformity

JURASSIC Middle
Jr Romana Sandstone

unconformity

Je Entrada Sandstone
Jc Carmel Formation (Winsor and Paria River Members)
Jp Page Sandstone

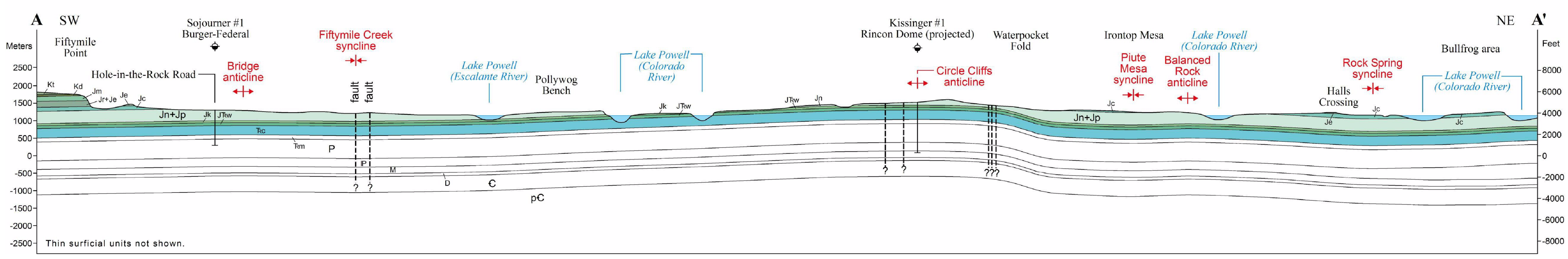
unconformity

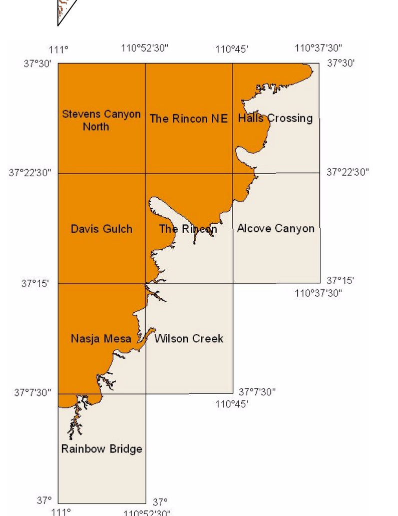
JURASSIC Lower
Jn Navajo Sandstone
Jk Kayenta Formation
JTRw Wingate Sandstone

unconformity

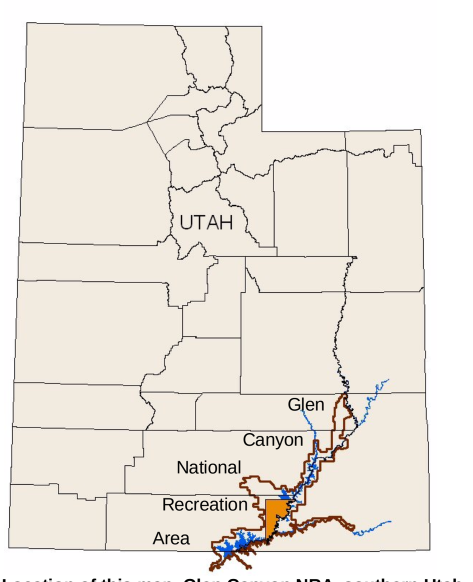
TRIASSIC Upper
TRcu Chinle Formation, upper unit (Church Rock, Owl Rock, Petrified Forest Members)

CROSS SECTION OF LOWER ESCALANTE RIVER AREA

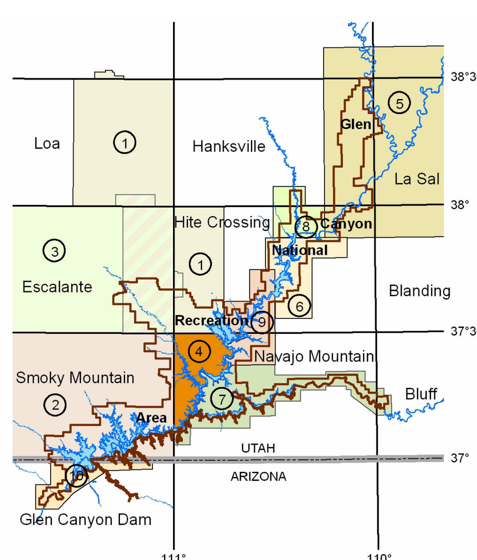




Index to U.S. Geological Survey 7.5' quadrangles



Location of this map, Glen Canyon NRA, southern Utah



Printed and GIS maps that cover Glen Canyon NRA at 1:100,000 or larger scale.

1 Billingsley, G.H., Huntoon, P.W., and Breed, W.J., 1987, Geologic map of Capitol Reef National Park and vicinity, Emery, Garfield, Kane, and Wayne Counties, Utah: Utah Geological and Mineral Survey Map 87, scale 1:62,500. Geographic Information System (GIS) database files: http://science.nature.nps.gov/nrdata/datastore.cfm?ID=39074; digital map image: http://geology.utah.gov/maps/geomap/parkmaps/pdf/M-87.pdf.

2 Doelling, H.H. and Willis, G.C., 2006, Geologic map of the Smoky Mountain 30'x60' quadrangle, Kane and San Juan Counties, Utah, and Coconino County, Arizona: Utah Geological Survey Map 213 and 213DM (digital GIS files), 2 plates, scale 1:100,000. (also see) Doelling, H.H., and Davis, F.D., 1989, The geology of Kane County, Utah, geology, mineral resources, geologic hazards: Utah Geological and Mineral Survey Bulletin 124 (also published separately as UGMS Map 121), 10 pl., scale 1:100,000, 192 p.

3 Doelling, H.H., and Willis, G.C., 1999, Interim geologic map of the Escalante and parts of the Loa and Hite Crossing 30'x60' quadrangles, Garfield and Kane Counties, Utah: Utah Geological Survey Open-File Report 368, 19 p., 2 plates, scale 1:100,000.

4 This map.

5 Huntoon, P.W., Billingsley, G.H., Jr., and Breed, W.J., 1982, Geologic map of Canyonlands National Park and vicinity, Utah: Moab, Utah, Canyonlands Natural History Association, scale 1:62,500. GIS database files: http://science.nature.nps.gov/nrdata/datastore.cfm?ID=38974. (also see) Doelling, H.H., 2004, Geologic map of the La Sal 30'x60' quadrangle, San Juan County, Utah: Utah Geological Survey Map 205, 2 plates, scale 1:100,000.

6 Thaden, R.E., Trites, A.F., Jr., Finnell, T.L., and Willis, G.C., 2006, Geologic map of the White Canyon - Good Hope Bay area, Glen Canyon National Recreation Area, Utah: Utah Geological Survey Miscellaneous Publication XXXDM, scale 1:50.000. (Digitized and modified from U.S. Geological Survey Bulletin 1125, scale 1:48,000, published in 1964)

7 Willis, G.C., 2004, Interim geologic map of the lower San Juan River area, eastern Glen Canyon National Recreation Area and vicinity, San Juan County, Utah: Utah Geological Survey Open-File Report 443DM (digital GIS files), scale 1:50,000.

8 Willis, G.C., 2006 in preparation, Interim geologic map of the Hite Crossing and Lower Dirty Devil River area, Glen Canyon National Recreation Area, Garfield and San Juan Counties, Utah: Utah Geological Survey Open-File Report XXXDM, scale 1:50,000, CD-ROM.

9 Willis, G.C., 2006 in preparation, Interim geologic maps of the Bullfrog, Halls Crossing, Halls Crossing NE, Ticaboo Mesa, and Knowles Canyon quadrangles, Glen Canyon National Recreation Area, Garfield and San Juan Counties, Utah: Utah Geological Survey Open-File Report XXXDM, scale 1:24,000, CD-ROM.

10 Willis, G.C., and Cragun, S., 2006 in preparation, Interim geologic map of the Glen Canyon Dam to Lees Ferry area, Glen Canyon National Recreation Area, Garfield and San Juan Counties, Utah: Utah Geological Survey Open-File Report XXXDM, scale 1:50,000, CD-ROM.

Area where Escalante Map overlaps Capitol Reef Map

[Printed and GIS database files available at: Utah Department of Natural Resources Map and Bookstore: web: geology.utah.gov; email: bookstore@utah.gov; phone: 1-888-UTAHMAP

This map is a plot of Geographic Information System (GIS) files created to visually represent the content of the GIS data files. It is not a published map and it contains many features that do not meet UGS cartographic standards, such as automatically generated labels that may overlap other labels and lines.

This geologic map and digital dataset were funded by the Utah Geological Survey and the National Park Service. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

SCALE 1:100,000

3 0 3 6 9 Miles

4 0 4 8 12 Kilometers

TRUE NORTH
MAGNETIC NORTH
11.53^0
205 mils

GIS digital cartography by: Buck Ehler and Darryl Greer
Base from U.S.G.S. Navajo Mountain (1981) 30'x60' quadrangle
Projection: UTM Zone 12
Units: Meters
Datum: NAD 1927
Spheroid: Clarke 1866

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Utah Geological Survey Map 217DM
GIS digital cartography by: Darryl Greer and J. Buck Ehler

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NOTICES

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DESCRIPTION OF MAP UNITS

Quaternary

Alluvial Deposits (Holocene) – Small amounts of poorly to moderately sorted alluvial gravel, sand, silt, and clay are common in the bottom of most drainages; however, because canyons are narrow and deposits are small, none are mappable at this scale; these alluvial deposits consist of poorly to moderately well sorted boulder to pebble gravel, sand, silt, and clay deposited in small drainages; and locally include small debris-flow deposits, eolian sand and silt, colluvium, rockfall debris, low-level alluvial terrace deposits, and alluvial-fan deposits; includes deposits in active part of wash and up to about 20 feet (6 m) above wash floor; 0 to 20 feet (0-6 m) thick.

Qea **Mixed eolian and alluvial deposits** (Holocene to Middle? Pleistocene) – Moderately to very well sorted sand, silt, with lesser clay deposited by wind and locally reworked by water; locally mixed with small angular to subrounded rock fragments, pebbles, and cobbles deposited as sheetwash and ephemeral-wash alluvium; commonly capped by thick calcic soil (caliche) that commonly forms a resistant bench; common on broad stable surfaces where it partially covers the bedrock and includes residual lag of underlying rock; similar in setting and composition to Qe deposits except evidence of alluvial activity is more common and dune forms are less developed; much of the unit is locally derived; locally covers or partially covers undifferentiated coarse alluvial gravel and alluvial fan deposits; 0 to 15 meters (0-50 ft) thick.

Qes **Eolian sand** (Holocene to Middle? Pleistocene) – Well- to very well sorted, well-rounded sand with minor silt deposited by wind; forms poorly to well developed dunes, mounds, and sheet-like deposits in depressions and on the lee side of slopes where protected from erosion for long periods of time; locally slightly reworked by alluvial processes and burrowing animals; mostly derived from and present on upper surface of Navajo and Kayenta Formations; residual lag of underlying rock is common; locally has well-developed calcic soil (caliche); 0 to 15 meters (0- 50 ft) thick.

Qat **Alluvial river terrace deposits** (Middle to Lower Pleistocene) — Moderately to well-sorted cobble to pebble gravel and sand with minor silt and clay; form terrace remnants on benches and slopes near the Colorado River; clasts were transported by the river from sources in eastern Utah and western Colorado; includes reworked terrace deposits that drape down slope from the original deposits; present up to about 200 m (600 ft) above the modern river bed; mapped deposits (exposed above high lake level) probably about 0.5 to 1 million years old (Willis, 2004); terrace deposits are common at several levels between the river channel and the Lake Powell high-water line and are exposed when the lake is low; probably about 0 to 9 meters (0-30 ft) thick.

Qag **Alluvial gravels, undifferentiated** (Upper to Lower Pleistocene) – Poorly to moderately well sorted, boulder- to clay-sized, alluvial stream-terrace and pediment-mantle deposits preserved as remnants above present streams and washes; commonly dominated by gravel to small boulder sediments; composition reflects local sources; commonly includes eolian silt and sand and calcic soil that gradually accumulates in upper part of deposits such that older deposits have thicker accumulations; in general, older deposits are preserved at higher levels above nearby streams and washes, but various levels have not been differentiated; mostly Quaternary in age but age of highest-level deposits is poorly constrained; 0 to 18 meters (0-60 ft) thick.

Qms **Mass-movement landslides, slumps, and talus, undifferentiated** (Holocene to Pleistocene) **–** Includes rock-fall deposits, colluvium, talus, toreva blocks, landslides, slumps, and landslide complexes; very poorly sorted, chaotic deposits range in composition from silt to large blocks several tens of meters in average diameter; upper surfaces are typically hummocky; most landslides and slumps are inactive but some show evidence of historical movement or reactivation near incised washes and along lake shorelines; primarily form in weaker rock units of the Cretaceous Straight Cliffs Formation (forms cliffs and ledges of Kaiparowits Plateau just west of map border) and Tropic Shale near Fiftymile Point, and in the core of the Circle Cliffs anticline near The Rincon where rockfall debris is sliding on Chinle strata; in this area lake water and wave action has saturated and weakened Chinle strata and previously existing landslides, creating unstable slopes that are slumping into the lake, causing safety hazards (Grundvig, 1980); map unit locally includes alluvial, colluvial, and eolian deposits; highly variable from 0 to 75 meters (0-250 ft) thick.

Cretaceous

Kt **Tropic Shale (Upper Cretaceous, upper Cenomanian to middle Turonian) –** Medium-gray, yellow-gray, and olive-gray, fossiliferous, marine mudstone and shale with subordinate gray fine- to very fine-grained sandstone, bentonitic claystone, siltstone, and limestone in the upper and lower parts of the formation; forms badlands slopes; 150 to 230 meters (500-750 ft) thick to west (Doelling, 2006), but only lower about 60 meters (200 ft) preserved in map area.

Kd **Dakota Formation (Upper Cretaceous, Cenomanian, with possible upper Lower Cretaceous, Barremian to Albian) –** Interbedded gray-orange to light-brown sandstone, sandy mudstone and shale, carbonaceous mudstone, shaley sandstone, conglomerate, and dark-brown to black carbonaceous shale and coal; upper part is sandstone with marine fossils; middle part is ledge and slope-forming sandstone, mudstone, and coal-bearing unit; lower part is a discontinuous local basal conglomerate that fills paleotopographic lows and may be at least partly Early Cretaceous in age; forms ledges and slopes; deposited in coastal plain, shoreline, near-shore marine, and lagoonal environments; deposited unconformably across Morrison Formation (and older formations to west of map area [Doelling, 2006]); thickness varies significantly across short distances; regionally is 1 to 45 meters (3-150 ft) thick; within map area is about 14 to 17 meters (45-55 ft) thick.

Jurassic

Jm **Morrison Formation (Upper Jurassic) –** Yellow-gray, gray, and yellow-brown, ledge- and cliff-forming, lenticular conglomerate, conglomeratic sandstone, and sandstone, interbedded with subordinate green-gray to purple-gray, to dark red-brown, smectitic (swelling clay) mudstone; cut out just west of map area due to unconformity at base of Dakota Formation that cuts increasingly down-section to the west; outcrops in map area are primarily Salt Wash Member but thin slope-forming Brushy Basin Member may be present above the Salt Wash, and a thin interval of Tidwell Member may be present below the Salt Wash; deposited in fluvial-lacustrine environment unconformably across underlying Middle Jurassic units; 170 to 210 meters (550-680 ft) thick (Peterson and Barnum, 1973).

Jr **Romana Sandstone (Middle Jurassic) –** Gray-yellow, green-gray, yellow-gray, and light-tan, very fine- to fine-grained, medium-bedded to massive, planar to cross-bedded, calcareous sandstone with thin planar beds of reddish-brown, calcareous, sandy siltstone; forms massive to ledgy cliff; deposited in shallow marine, tidal flat, and eolian environments; 0 to 45 meters (0-145 ft) thick regionally; about 12 to 40 meters thick (40-130 ft) in map area.

Je **Entrada Sandstone (Middle Jurassic) –** Consists of two members (not mappable at this scale); the upper (Cannonville Member) is mostly red-brown, fine-grained sandstone that forms steep slopes to cliffs that is interbedded with earthy-weathering sandstone and siltstone that is commonly covered; the lower (Gunsight Butte Member) is orange-brown to yellow-gray, fine-grained, cross-bedded sandstone that weathers into smooth "slickrock" erosional forms and cliffs; unconformable with overlying Jurassic units; basal part is commonly contorted due to soft-sediment deformation associated with loading thick sand onto non-lithified mudstone and gypsum of underlying Carmel Formation; mostly eolian grading up into tidal flat environments; 220 to 240 meters (720-780 ft) thick (Peterson and Barnum, 1973).

Jc **Carmel Formation (Middle Jurassic) –** Combined Paria River and Winsor Members of the Carmel Formation; upper part (Winsor Member) is mostly medium- to dark-red-brown to yellow-brown, slope-forming, earthy-weathering, silty sandstone and siltstone intercalated with sporadic irregular beds of white, calcareous, fine-grained sandstone that is locally gypsiferous; lower part (Paria River Member) is mostly dark-red-brown siltstone and silty sandstone with a few tan to brown, fine-grained sandstone beds capped by white to pale-red-gray, silty to sandy, chippy-weathering limestone; conformable with Page Sandstone; deposited in shallow marine, sahbka, and tidal flat environment along southeast side of inland sea; 33 to 52 meters (110-170 ft) thick; upper part (Winsor Member) is 18 to 45 meters (60-150 ft) thick, lower part (Paria River Member) is 15 to 20 meters (50-65 ft) thick.

Jp **Page Sandstone (Middle Jurassic) –** Mostly pale yellow-orange, to red-orange, fine- to medium-grained, cross-bedded, quartzose sandstone, locally with thin, dark-red, basal siltstone and silty sandstone beds; unconformably overlies the similar-appearing Navajo Sandstone; in map area consists of three undifferentiated eolian cross-bedded sandstone tongues, the Harris Wash (lower), Thousand Pockets (middle), and Leche-e (upper) (Blakey and others, 1996); to the west and northwest the Judd Hollow Tongue of the Carmel Formation is between the Harris Wash and Thousand Pockets (Doelling, 2006) but in this map area the Judd Hollow is very thin to missing and is not mappable; 10 to 75 meters (30-250 ft) thick.

Jn **Navajo Sandstone (Lower Jurassic) –** Pale-yellow-gray, orange-gray, pale-red-brown, brown, and very pale-gray, massive, cross-bedded to locally convolute-bedded, fine- to medium-grained sandstone that forms prominent cliffs, domes and bare-rock outcrops; characterized by massive eolian cross-bed sets; lower part has planar beds that grade upward into cross-beds; has local limestone and dolomite lenses (interdunal playa or lake deposits); 290 to 425 meters (950-1400 ft) thick.

Jk **Kayenta Formation (Lower Jurassic) –** Ledge- and slope-forming, lenticular sandstone, siltstone, and mudstone with local limestone and intraformational conglomerate beds; mostly medium- to dark-red-brown, but red-orange, red-purple, white, and brown sandstone is common; deposited in alluvial floodplain to lacustrine environments; conformable with units above and below; 58 to 104 meters (190-340 ft) thick.

<u>Jurassic – Triassic</u>

JTRw **Wingate Sandstone (Lower Jurassic to Upper Triassic) –** Pale- to medium-red-orange to red-brown, massive, cliff-forming, fine- to medium-grained, cross-bedded sandstone; forms “walls” of broad, blocky, strongly jointed, smooth sandstone cliffs and bluffs; 60 to 90 meters (200-300 ft) thick.

<u>Triassic</u>

TRcu **Upper members of the Chinle Formation (Upper Triassic) (includes Church Rock [Rock Point of Lucas, 1993], Owl Rock, and Petrified Forest Members) –** Individual members are recognizable in the field, but are impractical to map separately at this scale; overall, unit forms a slope to ledgy slope that steepens upward to ledgy cliffs just below the massive Wingate Sandstone cliff. Approximately 70 meters (230 ft) of this combined map unit consisting primarily of Church Rock and Owl Rock Members is poorly exposed along the lower walls of Escalante Canyon and tributaries where it forms a low slope with scattered ledges and is commonly covered by talus; these members, and the Petrified Forest Member, are also present but most covered or incorporated in landslide debris in the core of the Circle Cliffs anticline at The Rincon. The Church Rock Member consists of interbedded red-brown to pale-red-brown siltstone and fine- to medium-grained, micaceous sandstone with abundant ripple laminations, mudcracks, and small-scale cross-beds; lenticular pebble and rip-up clast conglomerate beds are locally present near base; the Church Rock is similar in color to the overlying Wingate and forms a steep ledgy slope commonly draped with Wingate rock-fall debris. The Owl Rock Member consists of pale-green-gray, pale-purple-gray, and pale-red-gray, calcareous sandstone, mottled limestone, and siltstone; calcrete pedogenic paleosols (fossil soils) are abundant. The Petrified Forest Member consists of vibrant purple-red, red-gray, and green-gray, slope-forming, smectitic (swelling clay) mudstone and thin beds of fine- to coarse-grained sandstone.

Subsurface Units – shown on cross section only

TRc **Chinle Formation, undivided (Upper Triassic) (includes members described above, plus possible Mossback Member, Monitor Butte Member, and Shinarump Conglomerate Member)**

TRm **Moenkopi Formation (Lower Triassic)**

P **Permian strata**

IP **Pennsylvanian strata**

M **Mississippian strata**

D **Devonian strata**

C **Cambrian strata**

pC **Precambrian rock**

SOURCES AND REFERENCES

This map was compiled primarily from the 1:100,000-scale geologic map of Kane County (Doelling and Davis, 1989). The authors made significant modifications in 2005.

Blakey, R.C., Havholm, K.G., and Jones, L.S., 1996, Stratigraphic analysis of eolian interactions with marine and fluvial deposits, Middle Jurassic Page Sandstone and Carmel Formation, Colorado Plateau, U.S.A.: Journal of Sedimentary Research, v. 66, no. 2, p. 324-342.

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Doelling, H.H., and Davis, F.D., 1989, The geology of Kane County, Utah, geology, mineral resources, geologic hazards: Utah Geological and Mineral Survey Bulletin 124 (also published separately as UGMS Map 121), 10 pl., scale 1:100,000, 192 p.

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